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FULL-SCALE OBSERVATIONS OF THE SPEED OF FREE MOVEMENT OF GYNECOLOGICAL PATIENTS IN CHINA

The article examines the demographic indicators of China in the period from 1951–2017. A number of tasks was formed: carrying out full-scale observations of the parameters of the movement of gynecological patients, statistical processing of the data obtained and comparative analysis with these parameters of the movement of our compatriots. A visual method of field observations of the parameters of the movement of patients of the gynecological department of the polyclinic of the Harbin University of Technology in China is described. Statistical processing of the motion parameters obtained as a result of field observations was carried out. Based on the results of statistical processing of field observations, the rate of free movement of patients was established. When differentiating the obtained statistical data of the parameters of free movement of patients, such classifications as gender, age and professional affiliation were adopted. According to the obtained values of the average speed of free movement of patients, a comparative analysis was carried out with the data of studies conducted in the territory of Russia. As a result of the research, the conclusion was made that the rate of free movement of gynecological patients in China exceeded the corresponding indicators of our compatriots.

Keywords: fire safety; evacuation; free movement parameters; maternity homes; experiment.

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Introduction

The population of the Earth in 2018 is about 7.5 billion people. Of these, 1.5 billion people live in China, which is 20 % of the total. Based on these statistics, China is the leader in terms of population.

According to an independent assessment at the end of 2016, the population of China was 1 382 494 824 people, in 2017 it was 1 401 109 752. Fig. 1 shows China's population growth trend from 1952 to 2016.

Fig. 1 shows a tendency of reducing population growth. This factor is not an accident, but deliberate actions of the authorities.

China was forced to legislatively restrict the size of the family in the 1970s, when it became clear that a huge number of people were overloading the land, water and energy resources of the country.

With such amount of population, ensuring its safety and comfort itself became a priority task of the state.

With the ratio of population to area, China ranks 9th, with a population density of 648 people per 1 km^2, or 0.648 people per 1 m^2.

Such an indicator, as population density, has a great influence on all spheres of activity of China, especially on the construction industry [1]. Due to the high density of population, in designing buildings and structures in China, its carrying capacity becomes the main parameter [2–7].

The purpose of this article is to determine the speed of free movement of the main composition of the human flow in the gynecological department of a clinic in China.

In the initial stage of the fire, the vast majority of communication paths are used as evacuation routes and exits [8–10]. In these situations, they are a fire protection system for a building or structure [11–13].

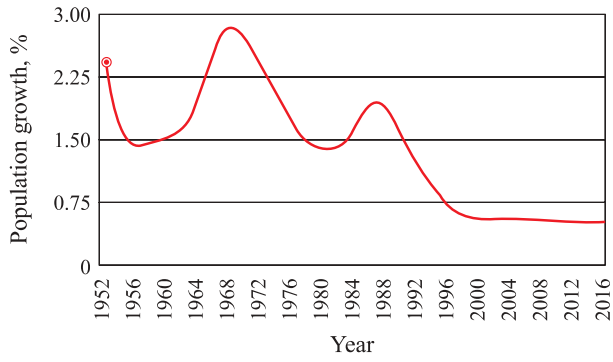

Fig. 1. The increase in the population of China in 1952–2016

Fig. 2. The process of visual method of carrying out full-scale observations of human movement

Communication paths of buildings should ensure the comfort of movement of people during their daily stay in the building, free movement of people in the event of their early (evacuation) evacuation from the building when approaching emergency situations of natural origin or the threat of terrorist attacks, as well as the unhindered and timely simultaneous evacuation of people technogenic accidents and in case of fire [13, 14].

In order to provide these functions with communication routes, it is necessary to analyze the size of the formed human flows, staying in buildings of various functional purposes, depending on the kinematics of their movement, the psychophysiological properties of their constituent people, and psycho-physically determined [15–17] relationships between flow parameters [18–20].

During the passage of the practice of sharing international experience between the National Research Moscow State University of Construction and Harbin University of Technology in 2017, the postgraduate student of the NRU MGSU O. S. Zosimova managed to organize full-scale observations of the speed of free movement of gynecological patients in the clinic of Harbin Polytechnic University. For reference: Harbin is

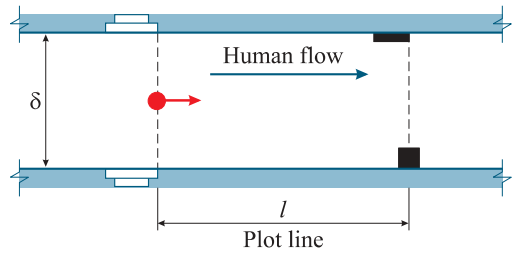

Fig. 3. Scheme of the section of the path on which the density and flow velocity are measured

located in the northeast of China and is the administrative center of Heilongjiang Province.

Observations were conducted in the corridor of the 2nd floor of the polyclinic, where the gynecological office was located.

Currently, there are two methods of field observations: visual method of observation and using video-photo equipment.

Considering the lack of the ability to use the film method of field observations, a visual method was used [21, 22]. In this connection, the time interval during which the distance traversed by the observed person was counted was determined, and flux density D (person/m^2). For the accuracy and uniformity of the observation, a noticeable object (checkpoint) was chosen, namely the beginning of the seats in the corridor (Fig. 2).

Methods

After selecting the time interval, the control point and the observed person, the following steps were taken.

When the observed person crossed the visual line, the number of floor tiles passed by him over a time interval of 5 seconds was calculated (Fig. 3).

It is necessary to note the following. The importance of the choice of a constant in the form of time in both the visual and film methods of field observations was first substantiated by prof. V. V. Kholshchevnikov in his works [23].

Previously, using the visual method of field observations, the distance traveled by the observed value was taken as a constant value. However, during the performing mathematical calculations with the data of field ob-

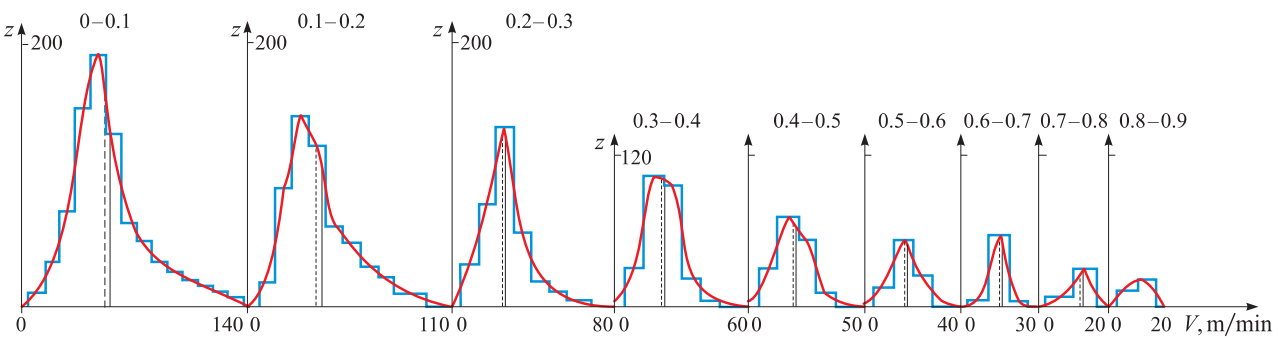

Fig. 4. Examples of histograms and polygons of velocity distribution along horizontal paths obtained by the visual method (z — F-test)

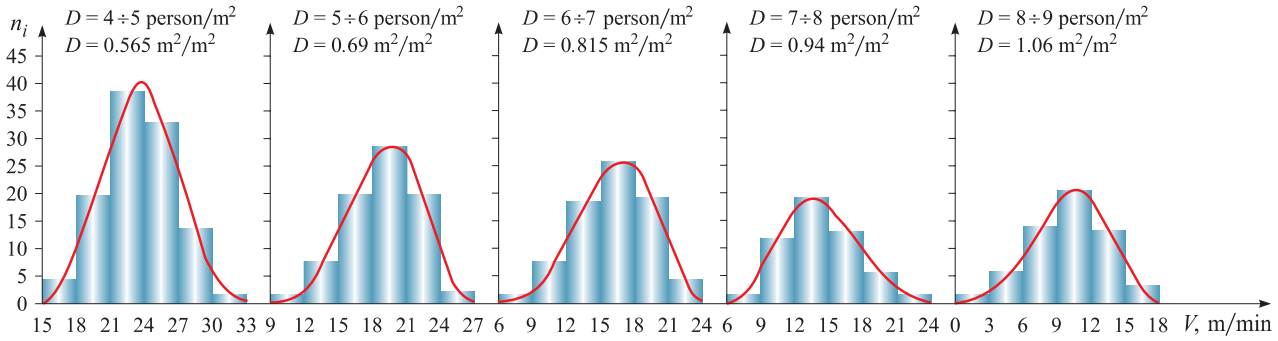

Fig. 5. Normal distribution of the speed of movement of people obtained at the film method (n_i is number of observations)

servations obtained by the visual method, V. V. Kholshchevnikov came to the conclusion that when using the visual method, the function gives the form of an asymmetric form of the probability density distribution law (Fig. 4), so that it is impossible to determine the actual form of the distribution law from the data of the visual observation method [24–26].

In all the studies conducted by the film method, normal distribution laws were obtained (Fig. 5).

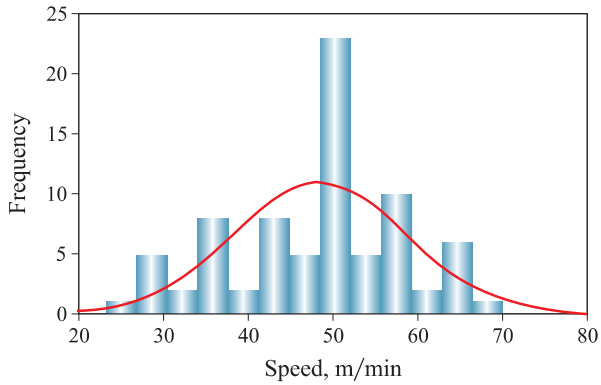

Fig. 6. Speed of movement of the patients of the gynecological department in China: the number of observations is 78; mathematical expectation μ is 48.4 m/min; standard deviation δ is 10.12 m/min; confidence interval for the mean: lower limit is 46.12 m/min, upper limit is 50.68 m/min

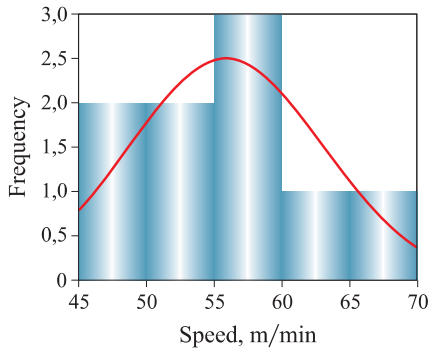

Fig. 7. Speed of movement of medical personnel of gynecological department in China: number of observations is 9; mathematical expectation μ is 55.9 m/min; standard deviation δ is 6.72 m/min; confidence interval for the mean: lower limit is 50.75 m/min, upper limit is 61.1 m/min

The current situation led to a modification of the visual method of field observations. The solution was the following: when carrying out the visual method of field observations for a constant, the time taken by a person to go through a particular section of the path is taken.

Results

To differentiate the results of observations, the following indicators were chosen: gender, age, professional affiliation (Fig. 6–8).

Got during realization of experiment data about average speed of free movement *V* of patients of gynecological department clinics on a horizontal path in China are represented in Table 1.

Although women make up the basic human composition of the gynecological department, it was also in-

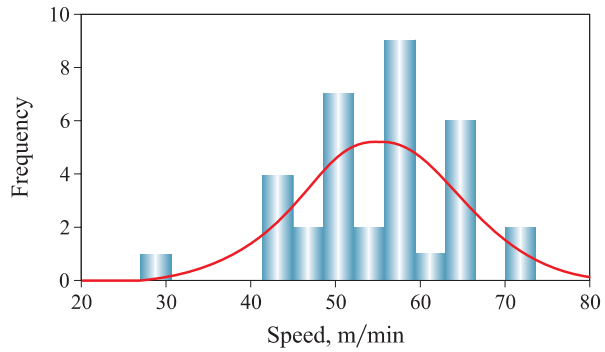

Fig. 8. Speed of movement of men in the gynecological department in China: number of observations is 34; mathematical expectation μ is 55.1 m/min; standard deviation δ is 9.18 m/min; confidence interval for the mean: lower limit is 51.9 m/min, upper limit is 58.3 m/min

Table 1. Average speed of free movement *V* of patients of gynecological department clinics on a horizontal path in China

No.	Category of observed patients (age, years)	*V*, m/min
1	Women 20–30	48.8
2	Women 31–45	48.4
3	Women 46–70	42.5

Table 2. Average speed of free movement of doctors (men and women) gynecological department of the polyclinic and of men on a horizontal path in China

No.	Category of observed people	*V*, m/min
1	Doctors (men and women)	55.76
2	Men	55.10

teresting to determine the speed of free movement of doctors, as well as men (Table 2).

Conclusion

The data of the table show that the values of the speed of movement of Chinese women differ from the speed of Russians, but it is somewhat lower. It is assumed that this difference is associated with smaller anthropometric body size, and accordingly the length of the step.

As a result of the present study, one of the tasks has been established: the speed of free (without the influence of density) movement of pregnant women has been established in different types of pathway. The obtained results are necessary for constructing a fire safety system for the protection object, but not sufficient, since the behavior of pregnant women in the initial stage of the fire and the time spent at this stage have not been established, and the flow parameters have not been established, however, studies in this area are actively continuing.

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